Robust Path Planning for Space Exploration Rovers

Completed Technology Project (2013 - 2017)

Project Introduction

Motion planning considers the problem of moving a system from a starting position to a desired goal position. This problem has been shown to be a computationally challenging task. This mainly arises due to complexity of the system being controlled and environmental factors that occur in the real world, such as sensor noise and imperfect actuation. The system being controlled might also have many degrees of freedom, allowing more complex tasks such as manipulation of the environment. A motion planner that can handle these type of disturbances and capabilities is ideal to produce robust paths that robotic systems can follow. The proposed work will attempt to address these issues by building off of state-of-the-art research in asymptotically optimal sampling-based motion planning. This process will involve developing an algorithm that can efficiently solve the motion planning problem for system that have dynamic constraints on their movement, e.g. car-like vehicles. By developing an algorithm that can provide optimality for dynamical systems, many other applications may be branched off of it. The first application to explore in this direction is planning under uncertainty. The uncertainty in environment and actuation is observed in the real world whenever we use a robotic system. This uncertainty is magnified when performing extra-terrestrial rover missions from ground stations here. It would be beneficial to have an autonomous planner be able to handle these disturbances, allowing ground crew to focus on more important tasks, such as waypoint selection.

Anticipated Benefits

The first application to explore in this direction is planning under uncertainty. The uncertainty in environment and actuation is observed in the real world whenever we use a robotic system. This uncertainty is magnified when performing extra-terrestrial rover missions from ground stations here. It would be beneficial to have an autonomous planner be able to handle these disturbances, allowing ground crew to focus on more important tasks, such as waypoint selection.

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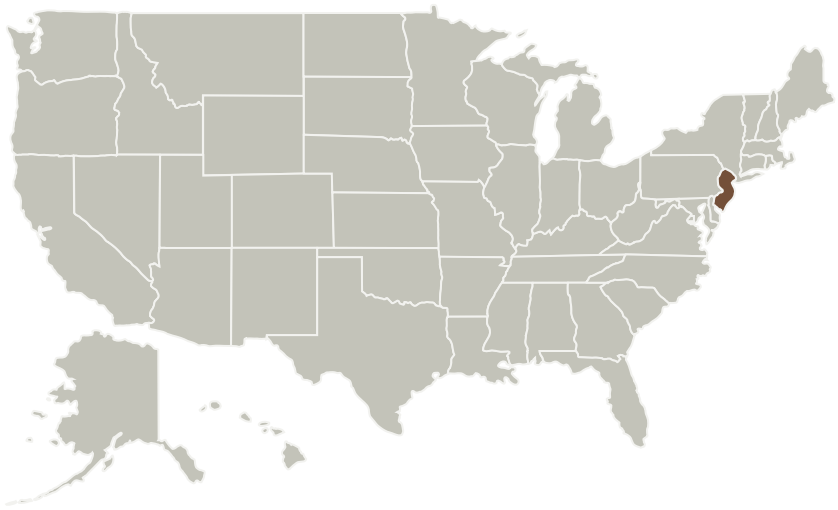
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Rutgers University-New Brunswick	Lead Organization	Academia Asian American Native American Pacific Islander (AANAPISI)	New Brunswick, New Jersey

Primary U.S. Work Locations
New Jersey

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Rutgers University-New Brunswick

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Kostas Bekris

Co-Investigator:

Zakary W Littlefield

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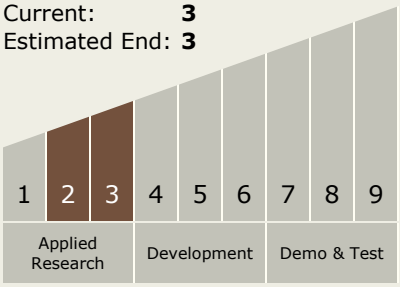
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.2 Reasoning and Acting
    - TX10.2.3 Motion Planning

Target Destinations

Mars, Others Inside the Solar System